CLAIMS

1. A polishing pad, comprising:

a polishing layer;

a backing layer; and

an acoustic window of solid material having an acoustic impedance less than that of the backing layer and extending through the backing layer to contact the bottom surface of the polishing layer, wherein the acoustic impedance of the acoustic window is between 1 and 4 MRayl.

2. The polishing pad of claim 1, where the acoustic window is non-porous.

3. The polishing pad of claim 1, where the acoustic window comprises a matrix material with liquid filled pores.

4. The polishing pad of claim 1, wherein the polishing layer comprises a porous portion and a non-porous portion that extends through the thickness of the polishing layer, and the acoustic window is arranged within the backing layer in contact with the non-porous portion.

5. The polishing pad of claim 1, wherein the polishing layer has a polishing surface with a first region without grooves and a second region that surrounds the first region that has a plurality of grooves, and wherein the acoustic window is aligned with the first region.

6. The polishing pad of claim 1, wherein a portion of the polishing pad directly above the acoustic window comprises a matrix material with liquid filled pores.

7. The polishing pad of claim 6, wherein the polishing layer has a substantially uniform composition including the matrix material with liquid filled pores across the polishing pad.

8. The polishing pad of claim 1, wherein the acoustic window has the same compressibility as a backing layer.

9. The polishing pad of claim 1, wherein the acoustic window and the backing layer are secured by an interface of intermingled polymer.

10. A chemical mechanical polishing apparatus, comprising:

a platen;

a polishing pad according to claim 1 supported on the platen;

a carrier head to hold a substrate against the polishing pad;

a motor to generate relative motion between the platen and the carrier head so as to polish an overlying layer of the substrate;

an in-situ acoustic monitoring system comprising an acoustic sensor coupled to the acoustic window to receive acoustic signals from the substrate; and

a controller configured to detect a polishing transition point based on received acoustic signals from the in-situ acoustic monitoring system.

11. A polishing pad comprising:

a polishing layer;

a backing layer; and

an acoustic window having an acoustic impedance less than that of the backing layer and extending through the backing layer and the polishing layer, wherein an upper surface of the acoustic window is coplanar with a polishing surface of the polishing layer, and wherein the acoustic impedance of the acoustic window is between 1 and 4 MRayl.

12. The polishing pad of claim 11, where the polishing layer is porous and the acoustic window is non-porous.

13. The polishing pad of claim 11, wherein the acoustic window and the polishing layer are secured by an interface of intermingled polymer.

14. The polishing pad of claim 13, wherein the acoustic window and the backing layer are secured by another interface of intermingled polymer.

15. A chemical mechanical polishing apparatus, comprising:

a platen;

a polishing pad according to claim 11 supported on the platen;

a carrier head to hold a substrate against the polishing pad;

a motor to generate relative motion between the platen and the carrier head so as to polish an overlying layer of the substrate;

an in-situ acoustic monitoring system comprising an acoustic sensor coupled to the acoustic window to receive acoustic signals from the substrate; and

a controller configured to detect a polishing transition point based on received acoustic signals from the in-situ acoustic monitoring system.

16. A method of fabricating a polishing pad, comprising:

successively depositing a first plurality of layers with a 3D printer to form a backing layer of the polishing pad, each layer of the first plurality of layers including a backing material portion and an acoustic window portion having a lower acoustic impedance than the backing material portion, wherein the acoustic impedance of the acoustic window portion is between 1 and 4 MRayl, the backing material portion and the acoustic window portion deposited by ejecting a plurality of precursor materials from one or more nozzles and solidifying the plurality of precursor materials to form a solidified backing material and a solidified acoustic window, wherein ejecting the plurality of precursor materials from the one or more nozzles forms an interface with intermingled polymer that directly bonds the solidified acoustic window and the solidified backing material; and

successively depositing a second plurality of layers with the 3D printer to form a polishing layer of the polishing pad on the backing layer.

17. A method for manufacturing a polishing pad, comprising:

depositing a backing layer comprising a first material;

curing the backing layer;

depositing a polishing layer atop the backing layer, the polishing layer comprising a second material;

curing the polishing layer;

removing a portion of the backing layer creating an aperture; and

inserting an acoustic window comprising a third material into the aperture, wherein an acoustic impedance of the acoustic window is less than that of the backing layer and wherein the acoustic impedance of the acoustic window is between 1 and 4 MRayl.